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PATENT ABSTRACTS OF JAPAN

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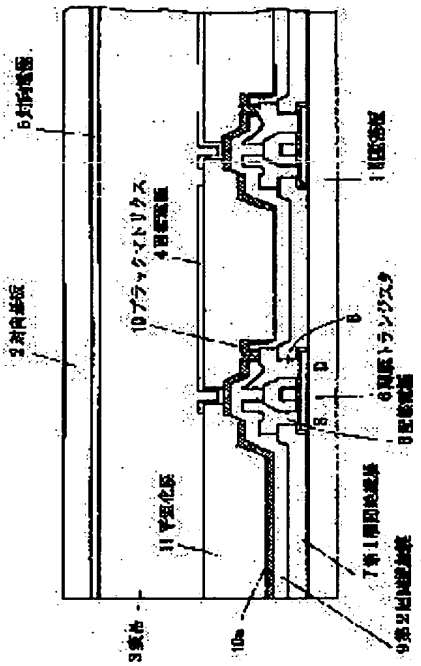
(54) DISPLAY DEVICE

(57)Abstract:
PURPOSE: To provide an on-chip black structure by providing an active matrix type display device with a black matrix on its driving substrate side.
CONSTITUTION: A driving substrate 1 and a counter substrate 2 are joined to each other via a prescribed spacing and liquid crystals 3 are held therebetween. While the driving substrate 1 has pixel electrodes 4 arranged in a matrix form, the counter substrate 2 has a counter electrode 5 formed over the entire surface. The driving substrate 1 has plural thin-film transistors(TFTs) 6 which individually drive the pixel electrodes 4 to switch, first interlayer insulating films 7 which coat these TFTs 6, wiring electrodes 8 which are patterned and formed thereon and are connected to the TFTs 6, second interlayer insulating films 9 which coat these wiring electrodes 8 and the black matrix 10 which is patterned and formed thereon and shields the lower TFTs 6. The black matrix 10 is coated with a flattening film 11 and the pixel electrodes 4 are patterned and formed on the flattening film 11. The pixel electrodes 4 are connected via the black matrix 10 to the wiring electrodes 8.



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CLAIMS

[Claim(s)]

[Claim 1] Display equipped with the drive substrate which has the pixel electrode which is characterized by providing the following, and which has been arranged in the shape of a matrix, the opposite substrate which has a counterelectrode and was joined to this drive substrate through the predetermined gap, and the electrooptic material held in this gap. The aforementioned drive substrates are two or more TFT which carries out the switching drive of this pixel electrode separately. The insulator layer between the 1st layer which covers this TFT. The wiring electrode which patterning formation is carried out on it, and connects with this TFT. The black matrix which patterning formation is carried out on it with an insulator layer, and shades downward TFT between the 2nd layer which covers this wiring electrode.

[Claim 2] It is the display according to claim 1 which the aforementioned black matrix is covered with the flattening film, and is characterized by carrying out patterning formation of the aforementioned pixel electrode on this flattening film.

[Claim 3] It is the display according to claim 2 which the aforementioned black matrix consists of a metal membrane, and is characterized by having connected the aforementioned pixel electrode to a downward wiring electrode through this metal membrane.

[Claim 4] It is the display according to claim 2 which the aforementioned black matrix consists of a metal membrane of floating potential, and is characterized by having connected the aforementioned pixel electrode to this wiring electrode directly through this black matrix.

[Claim 5] The aforementioned wiring electrode is display according to claim 1 characterized by functioning as a black mask which overlaps the upper pixel electrode edge partially and borders this pixel electrode.

[Claim 6] It is the display according to claim 1 which the aforementioned drive substrate is classified into the pixel array section which includes the TFT this pixel electrode and for the switching drive, and the periphery which includes the drive circuit which operates this pixel array section, and is characterized by equipping the aforementioned opposite substrate with the black mask adjusted in this periphery.

[Claim 7] The black mask prepared in the aforementioned opposite substrate side while the black matrix prepared in the aforementioned drive substrate side extended also to the field of the periphery except this drive circuit in addition to the field of the TFT contained in this pixel array section is display according to claim 6 characterized by shading only the field

of this drive circuit alternatively.
[Claim 8] It is the display according to claim 6 which the aforementioned pixel array section has the effective pixel which consists of a pair with the TFT which carries out the switching drive of this pixel electrode and this, and the dummy pixel which consists of TFT lacking in the pixel electrode, and is characterized by covering the aforementioned dummy pixel with this black matrix extensively.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the display represented by the active-matrix type liquid crystal panel etc. It is related with the structure of a black matrix of shielding except pixel opening of display, in more detail.
[0002]
[Description of the Prior Art] With reference to drawing 8 , an example of the conventional display is explained briefly. Display joins the drive substrate 101 and the opposite substrate 102 through a predetermined gap, and has the panel structure which held liquid crystal 103 in this gap. The drive substrate 101 has the pixel electrode 104 arranged in the shape of a matrix, and two or more TFT 105 which carries out the switching drive of this separately. TFT 105 is covered with the insulator layer 106 between the 1st layer, and the wiring electrode 107 which carries out electrical connection to the source field S of TFT 105 is formed on it. The insulator layer 108 is formed between the 2nd layer so that this wiring electrode 107 may be covered, and the pixel electrode 104 mentioned above is formed on it. Electrical connection of this pixel electrode 104 is carried out to the drain field D of TFT 105 through the contact hole which carried out opening to the insulator layer 108 and the insulator layer 106 between the 1st layer between the 2nd layer. Moreover, patterning formation of the black mask 109 which consists of a metal membrane of shading nature is carried out around the drive substrate 101. On the other hand, the black matrix 110 which shields except pixel electrode 104 is formed in the internal surface of the opposite substrate 102. This black matrix 110 carries out patterning of the metal membrane which has for example, shading nature. Opening surrounded by the black matrix 110 has consistency in the pixel electrode 104. In order to bury the irregularity of this black matrix 110, the flattening film 111 is formed, and the transparent counterelectrode 112 is extensively formed on it.
[0003]
[Problem(s) to be Solved by the Invention] With structure, a part of black matrix is formed in the drive substrate

side by the periphery conventionally which was shown in drawing 8 , and all are prepared in the opposite substrate side in except [it]. For this reason, the precise alignment of an opposite substrate and a drive substrate is needed. In consideration of the alignment precision of an opposite substrate and a drive substrate, and the black matrix formation precision by the side of an opposite substrate, a pattern design is carried out mutually. In this case, the margin which absorbs an alignment error beforehand needed to be taken and the pattern of a black matrix is set as a large size. Therefore, the technical problem that the numerical aperture of a pixel falls victim occurs. Since alignment with precise opposite substrate and drive substrate is needed, the alignment equipment in connection with it also has the technical problem that it will become precise and expensive. The opposite substrate side has structure in which the black matrix, the flattening film, and the counterelectrode carried out the laminating. At the time of coating of this flattening film, it originates in the irregularity of a black matrix, and becomes easy to generate thickness unevenness. For this reason, gap unevenness arises between pixels and the technical problem that a contrast fall occurs occurs.

[0004]

[Means for Solving the Problem] The following meanses were provided in order to solve the technical problem of a Prior art mentioned above. That is, the display concerning this invention is equipped with the drive substrate which has the pixel electrode arranged in the shape of a matrix as fundamental composition, the opposite substrate which has a counterelectrode and was joined to this drive substrate through the predetermined gap, and the electrooptic material held in this gap. As a feature matter, the aforementioned drive substrate has the insulator layer and the black matrix which patterning formation is carried out on it and shades downward TFT between the 2nd layer which covers the wiring electrode which patterning formation is carried out on it with an insulator layer, and connects with this TFT, and this wiring electrode between the 1st layer which covers two or more TFT which carries out the switching drive of this pixel electrode separately, and this TFT.

[0005] Preferably, the aforementioned black matrix is covered with the flattening film, and patterning formation of the aforementioned pixel electrode is carried out on this flattening film. The aforementioned black matrix consisted of a metal membrane, and the aforementioned pixel electrode is connected to a downward wiring electrode through this metal membrane. Or the aforementioned black matrix

consisted of a metal membrane of floating potential, and the aforementioned pixel electrode is directly connected to this wiring electrode through this black matrix. Depending on the case, the aforementioned wiring electrode overlaps the upper pixel electrode edge partially, and functions as a black mask which borders this pixel electrode.

[0006] The aforementioned drive substrate is classified into the pixel array section which includes the TFT this pixel electrode and for the switching drive, and the periphery which includes the drive circuit which operates this pixel array section in one mode of this invention. In this case, the aforementioned opposite substrate is equipped with the black mask adjusted in this periphery. While the black matrix prepared in the aforementioned drive substrate side extends also to the field of the periphery except this drive circuit in addition to the field of the TFT contained in this pixel array section, you may make it the black mask prepared in the aforementioned opposite substrate side shade only the field of this drive circuit alternatively. The aforementioned pixel array section may have the effective pixel which consists of a pair with the TFT which carries out the switching drive of this pixel electrode and this, and the dummy pixel which consists of TFT lacking in the pixel electrode. At this time, the aforementioned dummy pixel is good also as structure extensively covered with this black matrix.

[0007]

[Function] According to this invention, the TFT by which accumulation formation was carried out is covered with the 1st layer mesenteriolum to a drive substrate, and is carrying out the insulation protection to it. Besides, patterning formation of the wiring electrode of TFT is carried out. This wiring electrode is covered with an insulator layer between the 2nd layer, and carries out an insulation protection. Furthermore, patterning formation of the black matrix which consists of a metal membrane on an insulator layer between this 2nd layer is carried out. While precision can improve [a black matrix] patterning by using a metal membrane, since insulating separation of the black matrix is carried out from the wiring electrode through the insulator layer between the 2nd layer, a short circuit defect etc. does not arise. Furthermore, a flattening film etc. is formed on a black matrix and patterning formation of the pixel electrode is carried out on it. Since electrical connection of this pixel electrode is carried out to a wiring electrode through the black matrix mentioned above, it can diversify the design of contact structure. By the above composition, the so-called on-chip black matrix structure is acquired, and the precise alignment of an opposite

substrate and a drive substrate becomes unnecessary. More perfect shading structure is acquired by preparing the black mask which covers only a periphery in an opposite substrate side depending on the case.

[0008]

[Example] With reference to a drawing, the suitable example of this invention is explained in detail below. Drawing 1 is the important section cross section showing the 1st example of the display concerning this invention. This display has the panel structure which joined the opposite substrate 2 which consists of glass etc. as well as the drive substrate 1 which consists of glass etc. through the predetermined gap so that it may illustrate. Liquid crystal 3 is held as an electrooptic material in the gap of both the substrates 1 and 2. Patterning formation of the pixel electrode 4 is carried out at the drive substrate 1 at the shape of a matrix. The pixel electrode 4 consists of a transparent electric conduction film of ITO or SnO2 grade. On the other hand, the counterelectrode 5 which similarly consists of a transparent electric conduction film is extensively formed in the internal surface of the opposite substrate 2.

[0009] Two or more TFT 6 which carries out the switching drive of the pixel electrode 4 separately as a feature matter of this invention at the drive substrate 1, The wiring electrode 8 which patterning formation is carried out on it with an insulator layer 7, and connects with TFT 6 between the 1st layer which covers this TFT 6, The insulator layer 9 and the black matrix 10 which patterning formation is carried out on it and shades downward TFT 6 are formed between the 2nd layer which covers this wiring electrode 8. Furthermore, the black matrix 10 is covered with the flattening film 11. Patterning formation of the pixel electrode 4 mentioned above is carried out on this flattening film 11.

[0010] The black matrix 10 consists of metal membranes, such as Ti, aluminum, and Cr. Since especially Ti has columnar-crystal structure and is excellent in etching nature, it is processible into a precise black matrix pattern. This black matrix 10 is shielding TFT 6 from outdoor daylight, as mentioned above. In this example, black matrix 10a has extended also in the periphery further. On the other hand, the pixel electrode 4 is connected to the wiring electrode 8 by the side of the drain field D through the black matrix 10. On the other hand, the wiring electrode 8 by the side of the source field S constitutes a signal line. This wiring electrode 8 consists of aluminum, Cu, Ti, Mo, W, or these alloys. As mentioned above, while [the 2nd layer] consisting of PSG, NSG, SiO2, SiN, etc., this wiring electrode 8 is covered with the insulator layer 9, and is electrically insulated from the black

matrix 10.

[0011] With reference to drawing 1 , the manufacture method of the display concerning this invention is explained briefly succeedingly. First, accumulation formation of TFT 6 is carried out on the drive substrate 1 which consists of glass etc., and it covers with an insulator layer 7 between the 1st layer. Subsequently, opening of the source field S of TFT 6 and the drain field D, and the contact hole open for free passage is carried out to an insulator layer 7 between this 1st layer. Furthermore, an electrode material is formed by the sputtering method or CVD, patterning of this is carried out to a predetermined configuration, and it is processed into the wiring electrode 8. The wiring electrode 8 linked to the source field S serves as a signal line, and functions as a black mask depending on the case. An insulator layer 9 is covered between the 2nd layer in piles to this wiring electrode 8. A part of wiring electrode 8 which carries out opening of the contact hole to an insulator layer 9 between this 2nd layer, and is carrying out electrical connection to the drain field D of TFT 6 is exposed. Then, a metal membrane is formed in the sputtering method or CVD, patterning is carried out to a configuration predetermined by etching, and the black matrix 10 is processed. This black matrix 10 is covered with the flattening film 11 which consists of transparent acrylic resin etc., and the irregularity of drive substrate 1 front face is absorbed. Opening of the contact hole is carried out to this flattening film 11, and a part of black matrix 10 is exposed. Finally, a transparent electric conduction film is formed, patterning is carried out to a predetermined configuration, and it is processed into the pixel electrode 4. Consequently, electrical connection of the pixel electrode 4 will be carried out to the drain field D of TFT 6 through the black matrix 10 and the wiring electrode 8. Thus, since it is on chip and the black matrix 10 can form in the drive substrate 1 side, only a counterelectrode 5 will be fundamentally formed by the opposite substrate 2 side. It becomes unnecessary therefore, to carry out alignment of the drive substrate 1 and the opposite substrate 2 precisely.

[0012] Drawing 2 is the important section cross section showing the 2nd example of the display concerning this invention. Fundamental composition is the same as that of the 1st example shown in drawing 1 , gives a corresponding reference number to a corresponding portion, and makes an understanding easy. A different point is that the black matrix 10 which covers TFT 6 is floating potential. By this relation, the pixel electrode 4 is connected to the wiring electrode 8 by the side of the direct drain field D through the black matrix 10. With this structure, since the black matrix 10 serves as floating

potential, **** which impresses unnecessary electric field to liquid crystal 3 is lost.

[0013] Drawing 3 is the important section cross section and part plan showing the 3rd example of the display concerning this invention. It has the same composition as the 1st example fundamentally shown in drawing 1 , and a corresponding reference number is given to a corresponding portion, and an understanding is made easy. As shown in (A), the wiring electrode 8 which is carrying out electrical connection to the source field S side of TFT 6 serves as a signal line. This wiring electrode 8 overlaps pixel electrode 4 upper edge partially, and functions as a black mask which borders the pixel electrode 4. This arrangement relation is shown in the part plan of (B). The wiring electrode 8 (signal line) laps with the edge of the pixel electrode 4 in part, and serves as a black stripe so that it may illustrate.

[0014] Drawing 4 is the important section cross section showing the 4th example of the display concerning this invention. Fundamental composition is the same as that of the 1st example shown in drawing 1 , gives a corresponding reference number to a corresponding portion, and makes an understanding easy. The drive substrate 1 is classified into the pixel array section which includes the pixel electrode 4 and TFT 6 for the switching drive, and the periphery which includes the drive circuit (illustration ellipsis) which operates the pixel array section so that it may illustrate. With this composition, the black mask 12 adjusted in the periphery mentioned above to the opposite substrate 2 side is formed. Moreover, the pixel array section has the effective pixel which consists of a pair with TFT 6 which carries out the switching drive of the pixel electrode 4 and this, and the dummy pixel which consists of TFT 6a lacking in the pixel electrode. This dummy pixel is extensively covered with black matrix 10a, and is. A dummy pixel is prepared by several pixels so that an effective pixel may be surrounded, it absorbs an electrostatic stress from the outside etc., and protects an effective pixel. Therefore, in order that a dummy pixel may receive stress intensively, failure and destruction tend to take place. In view of this point, black matrix 10a was made to extend and TFT 6a which constitutes a dummy pixel is extensively covered with this example. Moreover, this black matrix 10a laps with the black mask 12 prepared in the opposite substrate side in part. Therefore, shading of display becomes more perfect by both. Moreover, since black matrix 10a and the black mask 12 lap mutually with a comparatively big margin, they do not need to carry out alignment of the drive substrate 1 and the opposite substrate 2 with high degree of accuracy.

[0015] With reference to drawing 4 , the

manufacture method of this display is explained briefly succeedingly. First, TFT 6 and 6a is formed on the drive substrate 6 which consists of transparent glass etc., and it covers with an insulator layer 7 between the 1st layer. Opening of the contact hole is carried out to an insulator layer 7 between this 1st layer, and the source field S of TFT 6 and the drain field D are exposed in part. Under the present circumstances, it is not necessary to carry out opening of the contact hole about TFT 6a belonging to a dummy pixel. However, in this example, opening of the contact hole is carried out about TFT 6a of a dummy pixel as well as TFT 6 of an effective pixel. Then, an electrode material is formed in the sputtering method or CVD, patterning is carried out to a predetermined configuration, and it is processed into the wiring electrode 8. Subsequently, an insulator layer 9 is formed between the 2nd layer, and a part of wiring electrode 8 which carried out opening of the contact hole and has connected with the drain side of TFT 6 is exposed. On the other hand, opening of the contact hole is not carried out to TFT 6a used as a dummy pixel. Then, a metal membrane is formed in the sputtering method or CVD, patterning is carried out to a predetermined configuration, and the black matrices 10 and 10a are processed. Black matrix 10a is shielding completely TFT 6a used as a dummy pixel so that it may illustrate. After forming the flattening film 11 besides, opening of the contact hole which is open for free passage to the black matrix 10 is carried out. Finally a transparent electric conduction film is formed, patterning is carried out to a predetermined configuration, and it is processed into the pixel electrode 4. However, the pixel electrode 4 is not formed in a dummy pixel. On the other hand, the black mask 12 is formed only on the outskirts at the opposite substrate 2 side, and the counterelectrode 5 which consists of ITO etc. in piles on it is formed. As explained above, on the whole in this example, this is shielded by the black matrix by making a part for the several pixels circumference of the pixel array section into a dummy pixel. Since it is easy to produce a defect by the damage, the shake of a noise or a video signal, etc., let the several pixels circumference be a dummy. Moreover, in order to shade a periphery, the black mask is prepared in the opposite substrate side. This composition enables it to assemble display by the alignment free-lancer that there is no injury on an effective pixel.

[0016] Drawing 5 is the important section cross section showing the 5th example of the display concerning this invention. Fundamental composition is the same as that of the 1st example shown in drawing 1 , gives a corresponding reference number to a corresponding portion, and makes an understanding easy. It is

classified into the pixel array section which includes TFT 6 of the for [this example] the pixel electrode 4 and for the switching drive in the drive substrate 1, and the periphery which includes the drive circuit (illustration ellipsis) which operates this pixel array section like the 4th example shown in drawing 4 . The black mask 12 adjusted in this periphery is formed in the opposite substrate 2 side. In addition to the field of TFT 6 contained in the pixel array section, the black matrix 10 prepared in the drive substrate 1 side on the other hand extends also to the field of the periphery excluding [a part of black matrix 10a] a drive circuit. The aforementioned black mask 12 prepared in the opposite substrate side is shading only the field of a drive circuit alternatively.

[0017] With reference to the plan of drawing 6 , explanation is added about the physical relationship of the black matrices 10 and 10a and the black mask 12 which were explained above. The drive substrate 1 is classified into the pixel array section 13 which includes the pixel electrode 4 and TFT 6 for the switching drive, and the periphery 16 which includes the vertical-drive circuit 14 and the level drive circuit 15 which operate this pixel array section 13 so that it may illustrate. In addition, signal-line X and the gate line Y intersect perpendicularly mutually, and are prepared in the pixel array section 13. Moreover, the terminal 17 for external connection is also formed in the upper-limit section of the drive substrate 1. In addition to the field of the TFT contained in the pixel array section 13, in this composition, the black matrix prepared in the drive substrate 1 side has extended also to the field of the periphery except the vertical-drive circuit 14 and the level drive circuit 15. On the other hand, the black mask prepared in the opposite substrate side is shading alternatively only the field of the vertical-drive circuit 14 and the level drive circuit 15. Now, temporarily, if the surface vertical-drive circuit 14 where irregularity is intense and the surface level drive circuit 15 are shaded by the black matrix by the side of a drive substrate, it will lead to a defect that it is easy to generate a poor short circuit and an electrostatic damage. In view of this point, only the field of the vertical-drive circuit 14 and the level drive circuit 15 is shielded with the black mask by the side of an opposite substrate by this example. In addition, the terminal for a test used for measurement of the vertical-drive circuit 14 or the level drive circuit 15 of operation etc. may be prepared in the periphery of the drive substrate 1. What is necessary is to avoid only a test terminal and just to make a black matrix extend to a boundary region at this time.

[0018] Finally, drawing 7 is the important section cross section showing the 6th example of the display concerning this

invention. Fundamental composition is the same as that of the 1st example shown in drawing 1 , gives a corresponding reference number to a corresponding portion, and makes an understanding easy. In the 1st example, to having shielded the periphery by the black matrix by the side of the drive substrate 1, the black mask 12 is formed in the opposite substrate 2 side, and the periphery is shaded by this example.

[0019]

[Effect of the Invention] As explained above, according to this invention, it is effective in comparing a numerical aperture with the former and being able to improve to 1.4 or more times by forming a black matrix in a drive substrate side. Moreover, an opposite substrate side is effective in becoming only a counterelectrode and alignment becoming unnecessary by forming all black matrices in a drive substrate side. Or by forming a black matrix in a drive substrate side, and making the several pixels circumference into a dummy pixel, alignment becomes unnecessary or it is effective in requiring only simple appearance doubling. Thereby, the equipment cost and inspection cost for alignment can cut down sharply. By forming a black matrix in a drive substrate side, it becomes unnecessary to form the flattening film by the side of an opposite substrate, and is effective in permeability rising several% for the reason. Since it becomes unnecessary to prepare a flattening film in an opposite substrate side, the gap control between pixels becomes easy and it is effective in the unevenness within a field being lost.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section cross section showing the 1st example of the display concerning this invention.

[Drawing 2] It is the important section cross section showing the 2nd example similarly.

[Drawing 3] It is the important section cross section and part plan showing the 3rd example similarly.

[Drawing 4] It is the important section cross section showing the 4th example similarly.

[Drawing 5] It is the important section cross section showing the 5th example similarly.

[Drawing 6] It is the typical plan of the 5th example.

[Drawing 7] It is the important section cross section showing the 6th example similarly.

[Drawing 8] It is the typical fragmentary sectional view showing an example of the conventional display.

[Description of Notations]

1 Drive Substrate

2 Opposite Substrate

3 Liquid Crystal

4 Pixel Electrode
5 Counterelectrode
6 TFT
7 Insulator Layer between 1st Layer
8 Wiring Electrode
9 Insulator Layer between 2nd Layer
10 Black Matrix
11 Flattening Film
12 Black Mask